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ABSTRACT

The education pipeline in the United States from prekindergarten through the Ph.D. is failing to produce the workers needed to meet future demand. In the year 2000, 85 percent of new entrants to the workforce will be members of minority groups and women. The number of capable persons with disabilities will also rise. These three groups have historically been underrepresented in science and engineering. The need to fill needed positions can be met only by reaching out to these groups. Discussed in this document are the characteristics, goals and recommendations made by the Task Force on Women, Minorities, and the Handicapped in science and technology for the nation in general, and precollege education, higher education, and the federal government specifically. Also presented are brief discussions of the nature of American industry; parents; and the Black, female, disabled, American Indian, Hispanic, and Asian American population in the United States. (CW)

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Changing America: The New Face of Science and Engineering

Interim Report

The Task Force on Women, Minorities, and the Handicapped in Science and Technology

September 1988

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The Task Force on Women, Minorities, and the Handicapped in Science and Technology

330 C Street S.W.
Washington, D.C. 20201
(202) 245-7477

September 1988

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Preface

The Task Force on Women, Minorities, and the Handicapped in Science and Technology:

Established by the U.S. Congress in Public Law 99-383, Section 8, to report to the President, the head of each participating Federal agency, and the Congress;

Members are from 15 Federal agencies and leaders in the private sector and education;

Purpose is to develop a long-range plan for broadening participation in science and engineering;

Public hearings held in Albuquerque, Atlanta, Baltimore, Boston, Chicago, Kansas City, and Los Angeles between Fall 1987 and Spring 1988;

An interim report with recommendations is now being issued to emphasize that action rather than more study is needed;

Task Force report due again in December 1989 on progress being made toward implementation of the recommended plan;

The Task Force terminates on January 31, 1990.

Cochairs of the Task Force are:

Dr. W. Ann Reynolds
Chancellor of the California State University System

Mr. Jaime Oaxaca
Corporate Vice President of Northrop Corporation

Executive Summary

Our advanced industrial Nation—the America we have taken for granted for more than a generation—is changing.

Our society is changing: More people are old, fewer are young, more come from minority groups.

Our industry is changing: We are not the world economic leader we were for so long, but a competitor with other industrial nations.

Our education system is changing: Although our colleges and universities are the envy of the world, they are becoming more and more dependent on foreign students and faculty. Our precollege education system has reached a crisis state in which U.S. students are no longer competitive with those in other industrialized countries.

Our present scientific and engineering workforce—the foundation for U.S. technological, economic, and military leadership—is eroding due to retirements and declining student interest.

As a result, the Task Force now reports to the President, the Congress, and the American people that one of our most urgent tasks is to strengthen our science and engineering workforce. The educational pipeline— from prekindergarten through the Ph.D.—is failing to produce the workers needed to meet future demand. Indeed, unless parents, schools, colleges, professional societies, industry, State legislatures, Federal agencies, the President, and Congress act in concert, our national science and engineering workforce will continue to erode and the prospects for maintaining an advanced industrial society will diminish.

In the year 2000, 85 percent of new entrants to the Nation's workforce will be members of minority groups and women. Meanwhile the number of people with disabilities who can go out into the workplace will rise. These three groups have historically been underrepresented in science and engineering. The Nation can meet future potential shortfalls of scientists and engineers only by reaching out and bringing members of these underrepresented groups into science and engineering. America's standing and competitiveness depend on it.

Findings of the TaskForce

The Nation's leadership in science and engineering cannot be maintained unless the education pipeline from prekindergarten through graduate school is repaired so it can yield a larger and more diverse group of world-class scientists and engineers at all levels.

The factors— racism, sexism, and prejudice against people with disabilities— that have limited opportunities for many in America are also narrowing access to science and engineering careers.

Until now, the role of minorities, women, and people with disabilities in science and engineering has been widely seen only as an equity issue, rather than as the key to future national strength in science and technology.

Universities are not enrolling and graduating enough American students in science and engineering, especially those from underrepresented groups, to ensure our ability to meet demands for American scientists and engineers. Universities do not complement large enrollments of foreign graduate students with large enough numbers of Americans.

Federal agencies have not recognized or begun to address the demographic changes that are eroding the science and engineering workforce and which will affect the conduct of the Nation's research and development efforts in the 21st century.

Federal agencies have not been sufficiently interested in the issue to identify the impact of the $60 billion Federal research and development budget on underrepresentation in the Nation's scientific workforce. Programs for underrepresented groups were designed with equity as the goal, not with the goal of strengthening the Nation's science and engineering workforce.

Effective local intervention programs are demonstrating that young people from underrepresented groups can become quality scientists and engineers. However, such programs are too isolated and underfunded to meet national demand.

The entertainment industry—television, radio, movies, music—has an enormous impact on the minds and imaginations of youth. Some entertainment stimulates interest in and awareness of mathematics and science, but much entertainment sends negative images. Efforts to improve national mathematics and science achievement will not be successful unless the entertainment industry assists in bringing more young people through the education pipeline.

Industry has been active in the effort to raise high school graduation requirements and to support minority college students, particularly in engineering. However, long term, sustained, and systemwide activities are now in order.

Goals for the Nation

Goal #1

Changing America: The Nation should adopt the goal that all children born today, from all backgrounds, have a quality education, including mathematics and science education and the opportunity to participate in the science and engineering workforce to their fullest potential.

Goal #2

PreK-12 Education: The Nation should reform the preK-12 education pipeline so that our children's mathematics and science competence is better than that of students in countries with which we compete.

Goal #3

Higher Education: The Nation should increase the number and diversity of American students graduating in science and engineering. By the year 2000, we should produce enough professionals in these fields, including more from underrepresented groups, to meet the demand for faculty and for industry and Federal personnel.

Goal #4

Federal Research and Development: Federal research and development funds influence the Nation's entire science and engineering effort. They generate new knowledge, and employ and train scientists and engineers. These funds should be leveraged to help develop a more diverse, world-class generation of scientific and engineering workers by the year 2000.

Goal #5

Federal Employment: The Federal Government should continue to be a pacesetter in developing a work environment that is accessible, equitable, and favorable in attracting and advancing groups underrepresented in science and engineering.

Goal #6

Influence of Culture: Our Nation's future hinges on having an ample supply of people who achieve in mathematics and science, are science-literate, and perform technical jobs with world-class competence. The entertainment industry and the mass media— powerful influences in shaping society's values— must participate in reshaping popular attitudes toward science and engineering.

Highlights of Recommended Actions

Create a National Action Council on the Science and Engineering Workforce comprised of our country's highest leaders and charged to ensure that all sectors work actively to broaden participation in the Nation's science and engineering workforce.

School boards should ensure that teachers, principals, and counselors create a school and classroom climate of high expectations in mathematics and science for all students, particularly those from underrepresented groups.

Federal funds should be provided for improvement in mathematics and science educational achievement to school districts with significant enrollment of minority students.

University presidents should lead in creating a climate of action and accountability that accelerates the participation of underrepresented groups in all aspects of their institutions.

Universities should set quantitative goals for recruiting, retaining, and graduating more U.S. students in the sciences and engineering, especially from underrepresented groups. Science and engineering departments should set similar goals and take responsibility for ensuring that more students from these groups attain doctorates and obtain faculty positions. Forgivable educational loans could be provided to students from these groups who agree to pursue faculty careers.

The Federal government should initiate a National Research Scholars Program in Science and Engineering to increase the number and diversity of students earning the bachelor's degree in science and engineering; and establish a National Graduate Student Research Opportunities Program offering fellowships and research assistantships in science and engineering to members of minority groups, women, and students with disabilities. These should be linked to the National Research Scholars Program to ensure continuity of support for these students.

States should establish a Scholar Incentive Program so that the top high school graduates in underrepresented groups can major in science and engineering at any public education institution in their State.

States should link articulation between 2-year and 4-year institutions so that 2-year college students would be encouraged to obtain the bachelor's degree in science and engineering.

Federal agencies should assess the impact of their entire research and development budget on the development of the Nation's science and engineering workforce. Within one year each agency should also develop plans for significantly diversifying the science and engineering workforce.

Federal agencies should include more women, minority group members, and persons with disabilities on their science- and engineering-related advisory committees.

Federal agencies that employ scientists and engineers should continue to recruit, train and advance more from underrepresented groups.

Industry should continue to sound the alarm about how weak educational preparation of our youth contributes to the declining economic competitiveness of the United States, and support the national goal to raise the quality of mathematics, science, and computer instruction and student achievement, particularly for underrepresented minorities, women, and individuals with disabilities.

Industry should provide summer work and research opportunities to high school students from underrepresented groups and their teachers so they obtain hands-on experience and see practical application of the technical theories taught in the classroom.

Industry should join and support alliances with Federal agencies and minority and majority universities aimed at increasing the number of graduates and researchers who are minority group members, women, or people with disabilities.

A task force of representatives from the entertainment industry should be established to report in the next 18 months on how its industry, along with the mass media, can spark the imagination and values of all Americans to reach the six national goals set forth in this report.

I. Changing America

Science and engineering workers are vital to our advanced industrial society. But by the year 2010, we could suffer a shortfall of as many as 560,000 science and engineering professionals. As a result, America's economic strength, security, and quality of life are threatened.

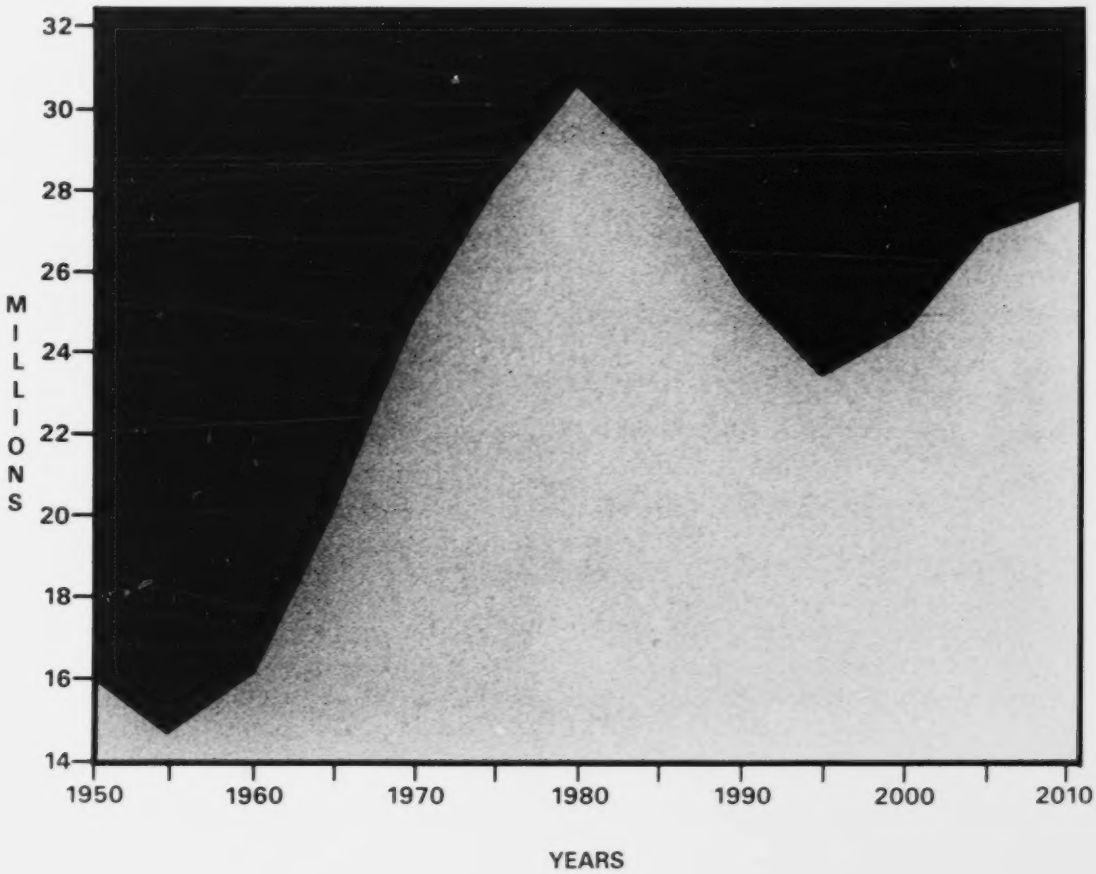
The percentage of young Americans preparing for careers in science and engineering has been declining steadily. Our most experienced scientists and engineers, recruited after Sputnik, will be retiring in the 1990s. Meanwhile, by the year 2000 the number of jobs requiring college degrees will increase dramatically. The educational pipeline—from prekindergarten through the Ph.D.—is failing to produce the scientifically literate and mathematically capable workers needed to meet future demand.

America is changing particularly in the composition of its young. Blacks and Hispanics are now 25 percent of our schoolchildren; by the year 2000, they will be 47 percent. This change has already occurred in some regions, such as California, New Mexico and Texas.

Thus, America is today a different country demographically from the one that produced earlier science and engineering feats. By the mid-1990s there will be fewer young people to enter the workforce, and these scarce young workers will have to be highly productive to keep our economy growing and maintain our standard of living. This means they will have to be versatile and well-educated, and if we are to continue as an advanced industrial society and world leader, many must join the science and engineering professions.

Since the early 1980s, the proportion of U.S. freshmen choosing science and engineering majors in college has been wobbling downward. The drop has been little noticed because many foreign students have been enrolling in these fields; in addition, colleges have been making up total enrollments with older and part-time students who tend not to graduate in science and engineering. If these trends persist, America will graduate fewer U.S. bachelor degree holders and, subsequently, even fewer Ph.Ds. in science and engineering.

Figure 1
18 to 24-Year-Olds in the U.S. Population, 1950-2010



Between 1980 and 2000 the 18 to 24-year-olds in the U. S. population will decline by 19 percent while the overall population will increase by 18 percent. By 2010, one in every three 18-year-olds will be Black or Hispanic, compared to one in five in 1985.

Source: U.S. Census Bureau.

We must find ways to bring many more young people— particularly those from underrepresented groups— into engineering and science. They must receive sound mathematics and science instruction in school, aspire to college, qualify for these majors at college, and complete their degrees. More baccalaureates must stay on as graduate students, as postdoctorals, and as teachers of future science and engineering students. Changing the mathematics and science interest and achievement of a generation of students is a huge task. It requires changing America.

We should commit to the task of producing a world-class science and engineering workforce not only because science and technology happen to be the coin of international power. We should take action not just because Japanese students score higher in international tests. We should take action not only because the opportunity costs of not acting— school dropouts, welfare, and prisons, for example— are staggering. We have two other powerful reasons:

One, every American citizen, regardless of background, gender, physical disability or race, should receive the educational and economic opportunity to develop to his or her fullest potential.

Two, we should extend these rights not only in the name of social justice, but as a test of a modern, well-functioning society. This is the standard by which we should continue to stand and be measured.

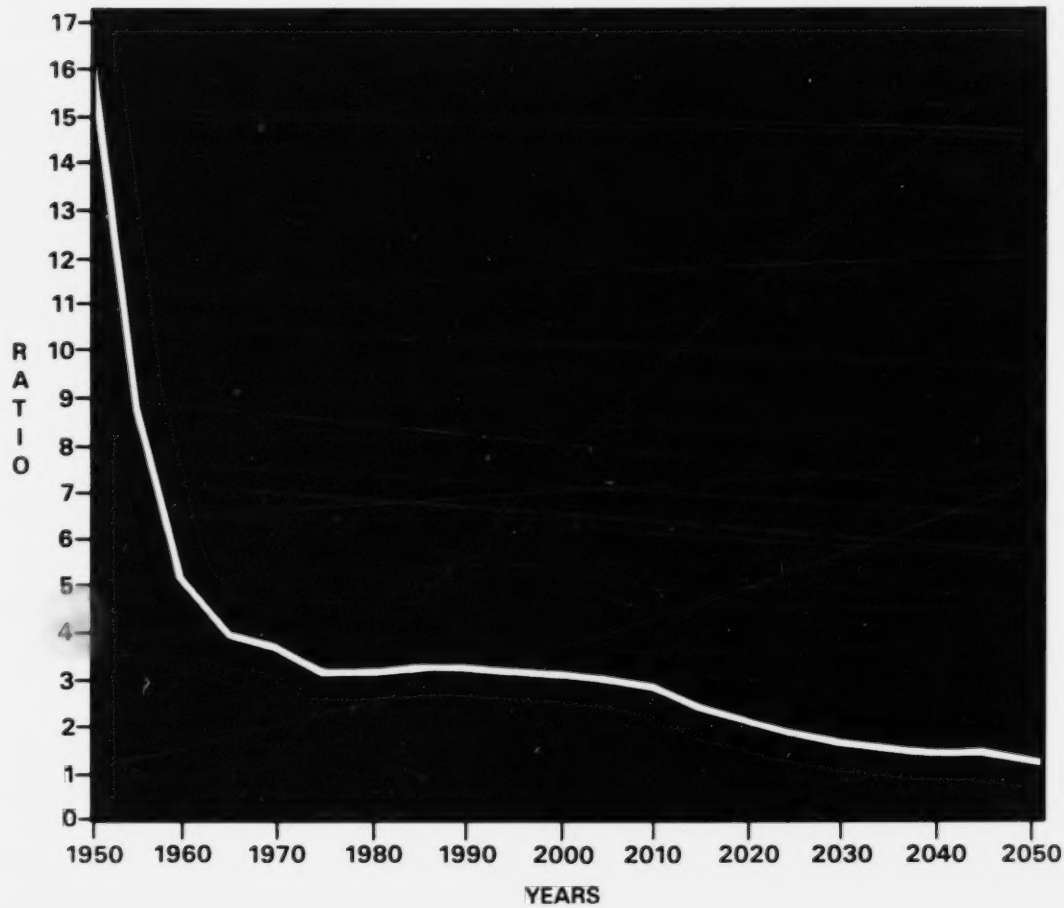
Because America is changing, we, in turn, must change America.

GOAL #1

The Nation should adopt the goal that all children born today, from all backgrounds, have a quality mathematics and science education and the opportunity to participate in the science and engineering workforce to their fullest potential.

Figure 2

Ratio of Workers to Social Security Beneficiaries, 1950-2050



The declining young population and increasing elderly population means that by 2050 there will be approximately one worker for each social security beneficiary. Presently the ratio is about three to one.

Source: U. S. Department of Health and Human Services.

Action: We respectfully suggest that the President articulate this goal. A National Action Council of our country's highest leaders should be created and charged to serve for 5 years to ensure that all sectors actively work to broaden participation in the Nation's science and engineering workforce. Council members should be made up of Federal agency heads, chief executive officers of industry, presidents of universities, heads of school systems, chairs of foundations, State governors and mayors. The Action Council should coordinate relevant programs, monitor progress across the Nation, and report yearly to the President, Congress and the American people.

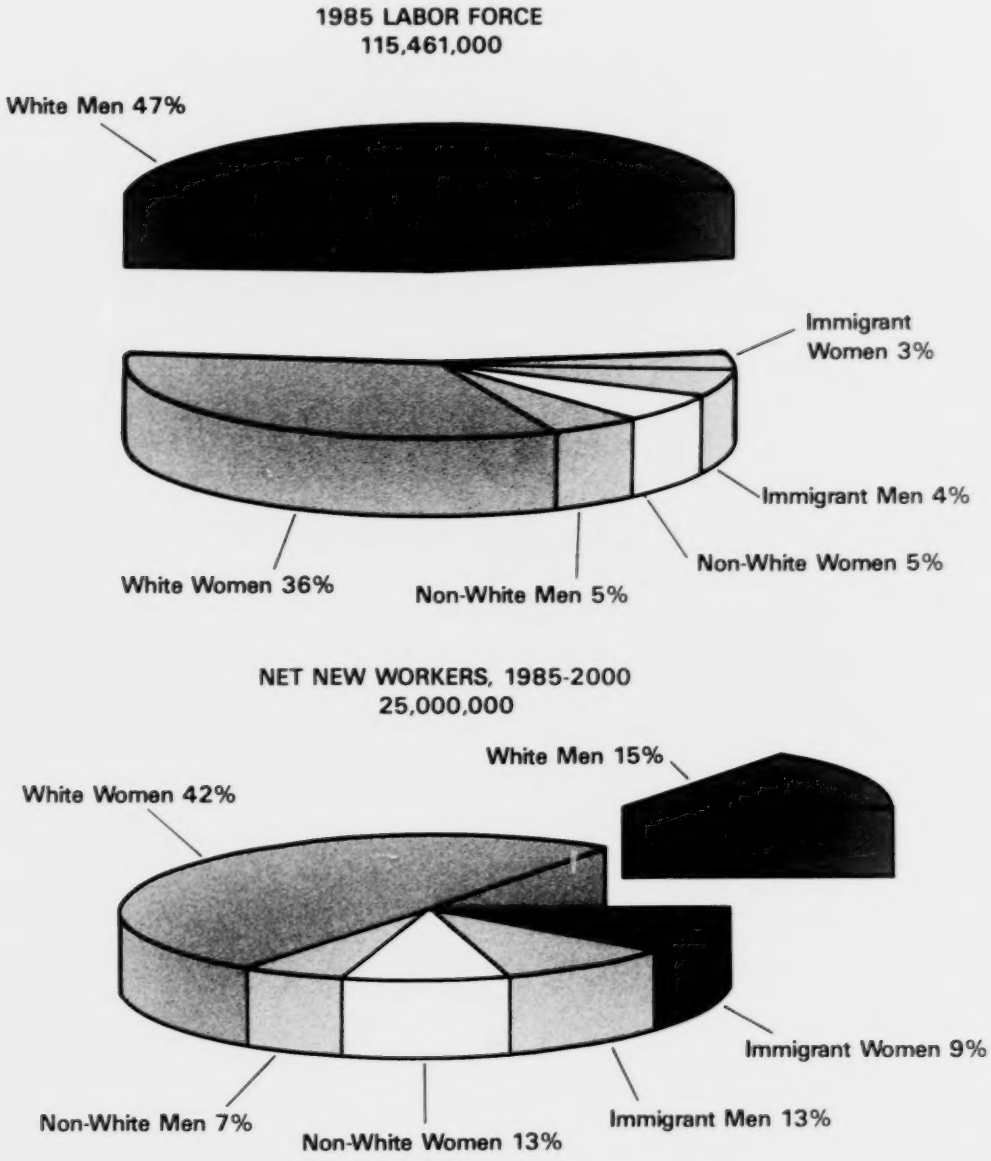
Action: To highlight industry's participation in meeting all six National goals set out in this report, we respectfully suggest that the President convene an annual meeting of chief executive officers of leading U.S. corporations to report on the state of the Nation's science and engineering workforce and the efforts of the business sector to develop a fully competitive workforce for the 21st century.

Action: Each State should exercise leadership in raising the quality of mathematics and science instruction and student achievement at the elementary and secondary levels. States should also take the lead in ensuring that their colleges and universities recruit and graduate sufficient numbers of students in sciences and engineering, especially from underrepresented groups.

Action: Professional societies should play a more active role in encouraging young people, especially from underrepresented groups, to pursue the study of mathematics and science. Programs offering financial assistance, summer work experience, career guidance and mentoring are particularly useful.

Figure 3

The Changing Labor Force, 1985-2000



Changing demographics will markedly affect the composition of the future workforce. Of the new workers entering the labor force by the year 2000, only 15 percent will be white men, and the rest either white women, members of minority groups, or immigrants.

Source: U.S. Department of Labor.

II. PreK-12 Education

A child born today will be in the sixth grade in the year 2000. That child will graduate from high school in 2006, from college in 2010, and enter the workforce when our society is about equally divided between young and old. These children will live in a world in which science and engineering will be crucial to the workplace and the economy, the conduct of public affairs, and the way we lead our private lives. Ignorance of mathematics and science—or fear of it—will hinder these children as workers and citizens.

Because children start to become engineers, scientists, or science-literate early in life, we should provide preschool programs that lay the groundwork for academic skills. This is especially important for the 14 million children who live in poverty, one-third of whom are from minority groups.

Minority students are concentrated in large urban school districts. These students tend to drop out of college-track mathematics and science early. These schools suffer from chronic shortages of good mathematics and science teachers, little or no hands-on laboratory science, and low teacher expectations. The situation is a Catch-22 for students who do not believe they can learn and, therefore, decide to avoid "hard" courses. The result is not only lower achievement scores for the Nation as a whole, but personal hardship for those students who have not been taught the skills they need to take full part in our advanced industrial society.

We know the key points at which most students in the United States drop off the mathematics-science pipeline. Junior high school is one. The decisions about which mathematics and science courses to take at this time could foreclose choices later. The little science presented is frequently taught by rote, and texts are often out of date. We emphasize the need for improvements in the science and mathematics preparation of all of our students, especially in the K-8 educational pipeline.

Industry

Industry is the Nation's largest research performer: it consumes three-fourths of all research and development dollars and employs two-thirds of our scientists and engineers, or 2.6 million people. Industry leaders have long known how central the science and engineering disciplines are to their success. Now they are facing up to the demographic issues that threaten their workforce. Many companies have been active in the effort to upgrade the workforce and reach out to groups who will be entering the labor force in the future. Business has been active in State movements to raise high school graduation requirements, including those in mathematics and science. Several companies support minority engineering programs and contribute to other intervention programs.

Long-term, sustained, and systemwide changes are now in order. Industry, therefore, should:

- Continue to sound the alarm about how weak educational preparation of our youth contributes to the declining economic competitiveness of the United States, and support the national goal to raise the quality of mathematics, science, and computer instruction and student achievement, particularly for underrepresented minorities, women, and individuals with disabilities.

- Through their industrial foundations, provide college scholarships and fellowships to members of underrepresented groups who are motivated to major in science and engineering and to teach those subjects at precollege and college levels.

- Join and support alliances with Federal agencies and minority and majority universities aimed at increasing the number of graduates and researchers who are minority group members, women, or people with disabilities.

- Provide summer work and research opportunities to high school students from underrepresented groups and their teachers so they obtain hands-on experience and see practical application of the technical theories taught in the classroom.

- Hire increasing numbers of people from underrepresented groups into scientific and technical positions.

- Promote and advance members of underrepresented groups through increasing levels of supervisory and managerial responsibilities, with special attention to removing the "glass ceiling," or invisible barrier, to their progression into senior management.

- Provide paid leave for employees to teach at precollege and college levels.

- Mobilize a national campaign for at least 5 years to increase science literacy and to show that mathematics, science, and technical learning are important to our country's well being and valuable in many kinds of careers.

The pattern of low expectations continues in high school, when students generally can choose general mathematics instead of college preparatory mathematics. For example, girls may consider physical science and mathematics to be male subjects and may not enroll in those classes without specific encouragement from parents, teachers and counselors. Students with disabilities frequently do not take laboratory science because of discouragement from teachers. Consequently, U. S. elementary and high school students take fewer math and science courses and learn less than do students in most other developed countries. As a result, they score very low on international tests of these skills and on national achievement exams. In 1988, for example, only 48.5 percent of U.S. 17-year-olds could pick the right multiple choice answer to the question: What is the area of a rectangle 4 cm by 6 cm?

We should change the climate in which students learn and teachers teach mathematics and science. We should instill the expectation—in parents, teachers, principals, and students—that students of all backgrounds can learn and be at ease with mathematics and science. These improvements require systemic change.

We commend the many schools that have begun to remedy this situation. The Education Commission of the States reports that since 1980 at least 45 states and the District of Columbia have strengthened graduation requirements. Generally, mathematics and science courses have led the increase. Three years of mathematics is the goal of these efforts. The momentum should continue.

To meet raised expectations of parents, teachers, and students, we need human and financial resources. School districts must have practical and systemic plans to raise mathematics and science achievement levels. They can be assisted by the Federal Government in ways that preserve the Federal Government's limited role.

Intervention programs, if replicated with care and given stable funding, can make a difference. For example, the Southeastern Consortium for Minorities in Engineering (SECME), sponsored by 27 universities and 45 corporations, coordinates intervention programs across the southeast United States to reach over 200 schools, 27 universities and 45 corporations, and approximately 15,000 minority students a year.

Parents

To provide all children, from all backgrounds, with a quality mathematics and science education and an opportunity to join the science and engineering workforce, we must reach parents. Parents shape the aspirations and values of children and influence their achievement in school. A prime objective of outreach to parents would be to offer parents and children a chance to learn together.

Simple aids, such as a pamphlet for parents called "Get Into the Equation" published by The College Board, are explaining why mathematics and science are important tools and how parents can help their children gain mastery of these subjects. It tells parents what toys to provide, what courses children should take in school, and how to interact with the school.

Linkages, developed by the American Association for the Advancement of Science, uses foundation funds to form community-based partnerships between schools, parents, community organizations, and even churches. Its aim is to improve the mathematics and science achievement of children-at-risk. In 3 years, it has reached an estimated 30,000 parents.

Family Math, developed at the Lawrence Hall of Science, Berkeley, gets parents and young children to learn math together and involves parents with their children's schools. In the last 5 years, Family Math reached 34,000 families.

Many science museums provide learning experiences for children and their parents. Some museums are also mounting targeted programs — for example, the camp-ins for Girl Scouts at the Center of Science and Industry at Columbus, Ohio; the programs linking the Girls Clubs of America and the Boston Science Museum; and exhibits such as "Black Achievers in Science" and "My Daughter the Scientist" at the Chicago Museum of Science and Industry. Museum facilities are frequently modified to accommodate people with disabilities, including easy access and technical aids for blind and hearing-impaired visitors.

The Comprehensive Math and Science Program (CMSP) in New York City randomly selects students in 9th grade and, using in-service teachers, offers them 4 years of college preparatory mathematics, including calculus. CMSP has reached more than 6,000 students to date. On New York State Regents mathematics exams taken in 1987, twice as many CMSP students as non-CMSP students passed. The program is being extended to some schools in Atlanta, Georgia.

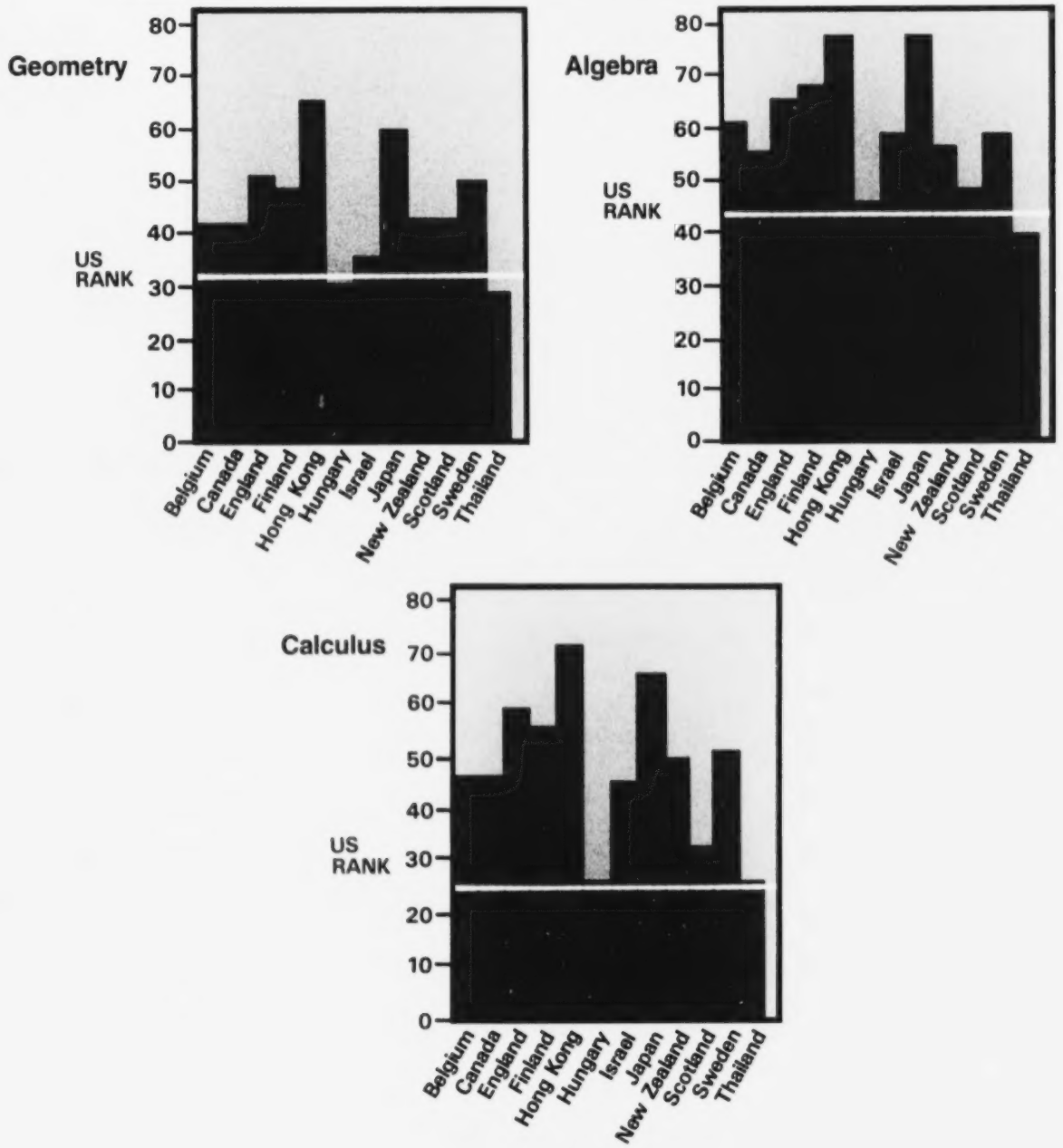
GOAL #2:

The Nation should reform the PreK-12 education pipeline so that our children's mathematics and science competence is better than that of students in countries with which we compete.

Action: PreK children can be helped if their parents – particularly those of children in poverty– understand the importance of mathematics and science education. Parents should hold schools accountable for raising student achievement levels in mathematics and science. Present community-based programs that stress parent outreach, should be extended. All children should have regular access to informal learning experiences in science museums and library media centers.

Figure 4

Twelfth Grade Scores on International Math Achievement Tests



Compared with students from other countries, U.S. students score in the lower end of the scale on mathematics achievement tests.

Source: International Association for Evaluation of Educational Achievement.

Action: To raise levels of mathematics and science achievement by minority students, educational reform should target the 25 largest school districts which enroll 60 percent or more minority students. Such districts should undertake a systemwide assessment of mathematics and science education and develop a plan for making student achievement better than that of students in nations with which we compete. The Federal Government should establish a competitive grants program for school districts to implement these plans, and continued funding would be dependent on measurable improvements in achievement of students.

Action: The maximum number of students—especially minority and women students and students with disabilities—should take college-track mathematics and science. High schools should require 3 years of mathematics including precalculus, and plan to require 4 years, including calculus, as soon as possible. Three years of laboratory science and one year of computer science should be required for graduation.

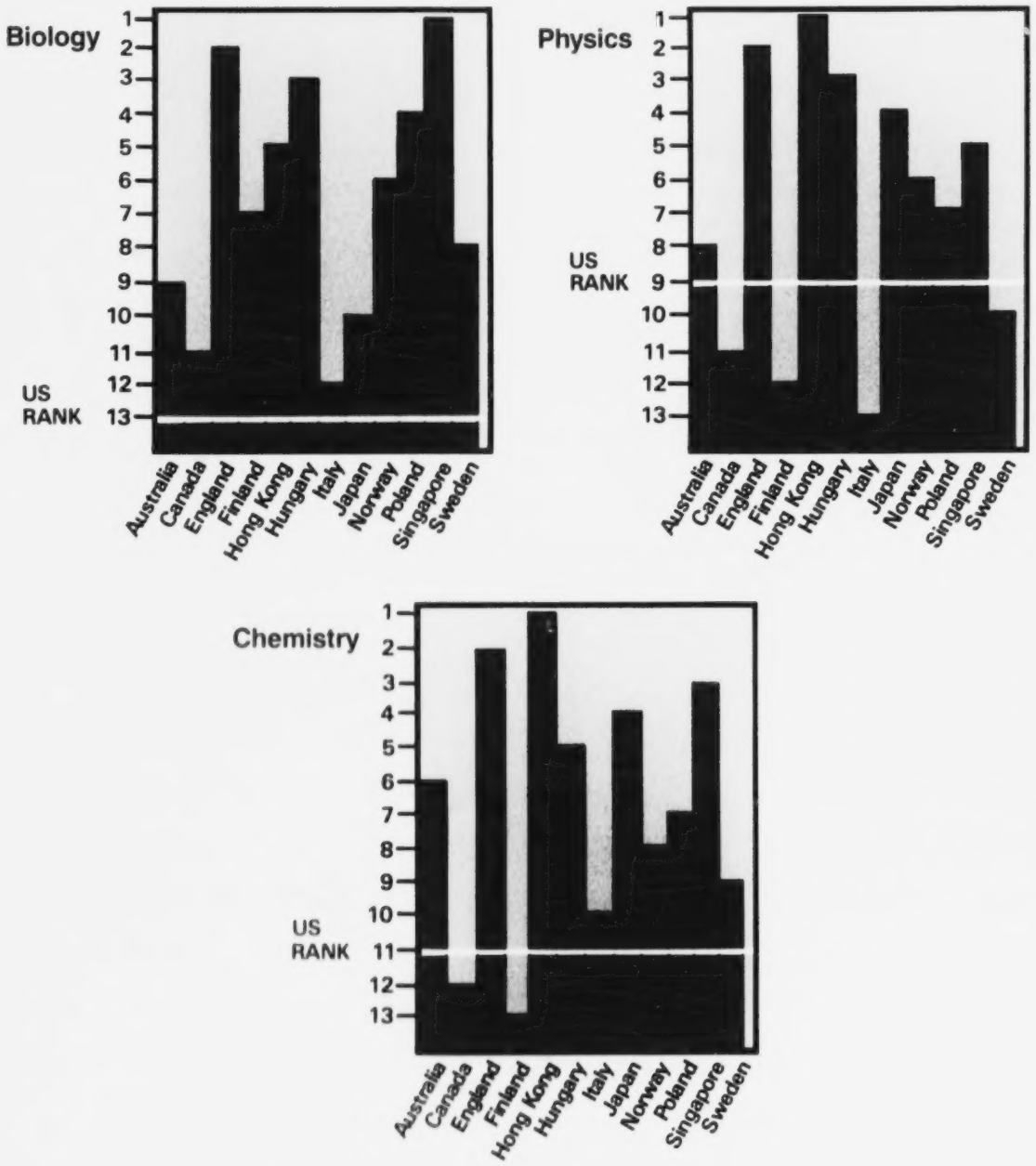
Action: Teachers and counselors should encourage students with disabilities to take laboratory science courses. Schools should provide technical aids and appropriate teaching to minimize physical barriers to achievement by students with disabilities.

Action: Teachers, principals, and counselors should create a school and classroom climate of high expectations in mathematics and science for all students, particularly for those from underrepresented groups.

Action: Professionalism of mathematics and science teaching should be accelerated through teacher institutes, workshops, retraining, and participation in Federal research projects.

Figure 5

Twelfth Grade Scores on International Science Achievement Tests



Among the 13 countries participating in these science achievement tests, U.S. students scored 13th in biology, 11th in chemistry, and 9th in physics.

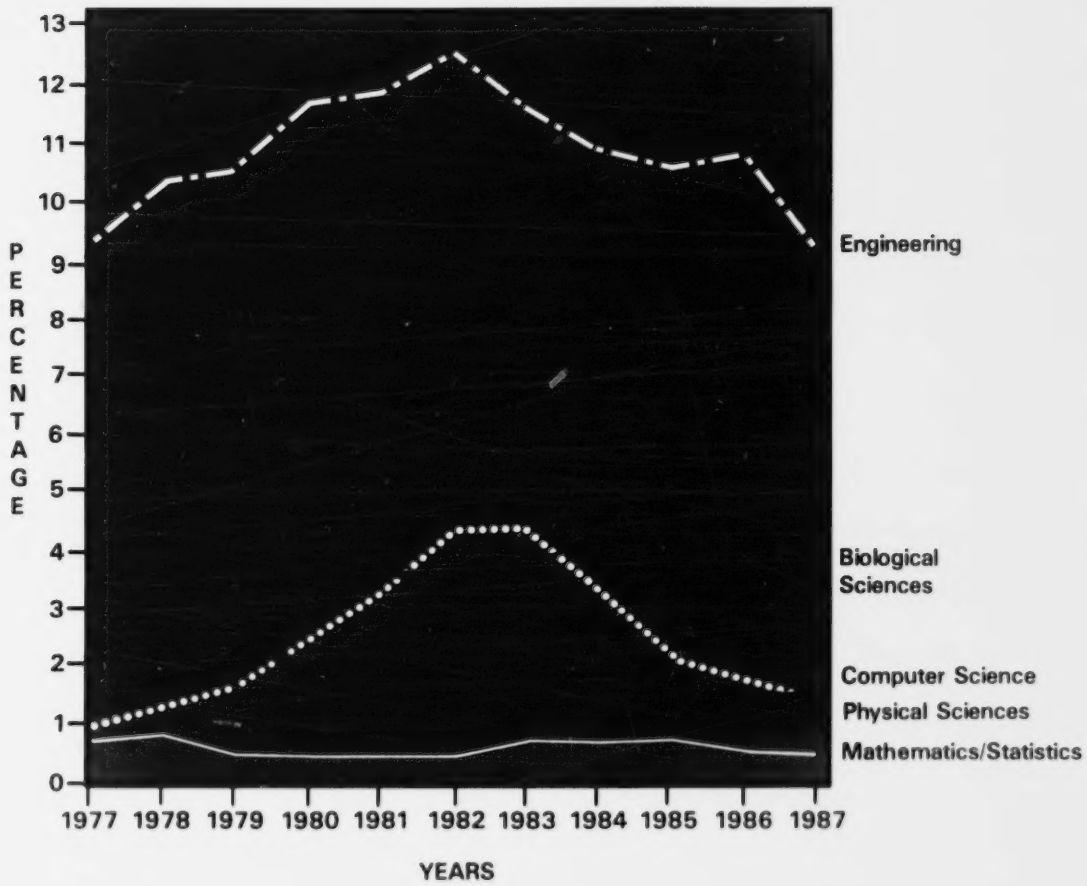
Source: International Association for Evaluation of Educational Achievement.

Action: To increase the present workforce of good science and mathematics teachers nationwide, forgivable educational loans should be made widely available to students who agree to become mathematics and science teachers. Scientists and engineers retiring from universities, Federal service and industry should be an important teaching resource in the 1990s. Industry and the Federal Government should be encouraged to permit employees to take paid leave to teach and counsel students in mathematics and science.

Action: Effective intervention programs should be expanded. If evaluated and replicated with care, and provided with secure funding, they can alleviate specific problems at the local level. However, they alone cannot solve the national effort to raise student mathematics and science achievement.

Figure 6

Student Interest in Science & Engineering, 1977-1987



Freshman interest in science majors has declined by one-third over the past two decades; the largest drop occurred in mathematics and the physical sciences. Interest in engineering is down by one-quarter since 1982, and interest in computing careers has fallen by more than two-thirds in four years.

Source: U.C.L.A. Higher Education Research Institute.

III. Higher Education

Our colleges and universities train our Nation's science and engineering workforce and perform cutting-edge research. They have a key role in producing an adequate supply of science and engineering degree-holders to meet demand, and in giving all groups in society access to the skills and knowledge that make America great. Fulfilling these responsibilities is especially important in a period of large-scale demographic change.

Although the number of women, Blacks, Hispanics, and American Indians in science and engineering increased through the early 1980s, the absolute numbers were small, and they are now declining. In addition, since 1983, fewer freshman overall have been planning to major in science and engineering, so the percentage of science and engineering degrees awarded will continue to drop.

The declining enrollment of U.S. graduate students is masked by recent high enrollments of foreign students in these fields, especially engineering. Today, 75 percent of the graduate students receiving financial support from university engineering departments are foreign nationals. The large presence of foreign nationals in these departments affects who are put on research teams, who receive fellowships and research assistantships, and who are eligible to become faculty members. The cultural attitudes of foreign students, particularly if they are instructors, may even discourage some Americans, such as women, from taking science and engineering courses.

Graduate departments in the United States not only train relatively fewer Americans, but they train even fewer graduate scientists and engineers who are Black, Hispanic, American Indian, or female. In 1986, 3,376 Ph.D.s were awarded in engineering by U.S. universities. Of this number, 1,661 went to U. S. citizens including, 139 to women, 25 to Hispanics, 14 to Blacks, and 6 to American Indians.

Blacks

Composition.
Blacks are 12 percent of the American population and 2 percent of all employed scientists and engineers. They earn 4 percent of the baccalaureates and one percent of the Ph.D.s in science and engineering. In 1986, only 89 Blacks who are U.S. citizens earned the Ph.D. in science, and 14 earned that degree in engineering.

Background.
Blacks started to enter the fields of science and engineering in increasing numbers in the 1970s, when minority engineering programs were launched at several majority institutions. Soon, Black undergraduate engineering enrollments rose, from 5,508 in 1973 to 17,994 in 1985, although this trend has reversed in the last year when the number declined to 16,803.

The pipeline.
As with other groups still underrepresented in science and engineering, the educational system turns many Black students away from these fields early in life. This is due, in part, to the fact that most Blacks are enrolled in the large city schools where teaching is below par. In 1984, for example, the population of the 25 largest school districts in the United States was 41 percent Black. Thus, test scores for Black students overall remain low despite the increasing movement of Blacks to higher socioeconomic levels.

Many Black students graduating from high school are deterred from entering college by the prospect of assuming loans that are sometimes equal to a family's entire annual income. Most Blacks who enter science and engineering do so through selected Historically Black Colleges and Universities (HBCUs). A large percent of the Blacks who have received advanced degrees in science and engineering elsewhere did their undergraduate work at these institutions. Nearly all Blacks who get bachelors' degrees in science and engineering take jobs immediately upon graduation. Few stay on for graduate study.

Model programs.
Intervention programs are beginning to provide the kind of support Black students need to pursue the science and engineering professions. The Illinois Institute of Technology's minority engineering program, for example, graduates about 70 percent of the entering freshmen minority students compared to the nationwide average of 30 percent. This high rate is attributable to: concerned leadership from the president of the institution; careful selection and training of faculty and staff; and the use of older student counselors who tutor newer students and help them understand the system. The National Consortium for Graduate Degrees in Engineering (GEM) similarly supports students to pursue graduate degrees.

Although women enter graduate school at about the same rate as men, they are considerably less likely than men to reach the Ph.D. They tend to be self-supporting rather than supported by the graduate departments. They cluster in the biological and health sciences.

These trends among the traditionally underrepresented groups need not continue; they can be reversed. On campuses where change has occurred, the presidents, deans, and department heads have provided strong leadership.

At the traditionally male Massachusetts Institute of Technology, for example, women have made up 38 percent of all freshmen for the past 3 years. As a result of institutional leadership, 100 of its 950 faculty are women. To encourage women to pursue research careers, MIT offers fellowships and other programs that carry high prestige and have helped many young women pursue academic research careers.

But colleges and universities cannot reach out to all groups, particularly the rapidly growing Black and Hispanic student pool, without first having faculty who themselves are from underrepresented groups. Graduate departments are cultures in themselves. These cultures must be changed to reflect and attract the traditionally underrepresented.

GOAL #3:

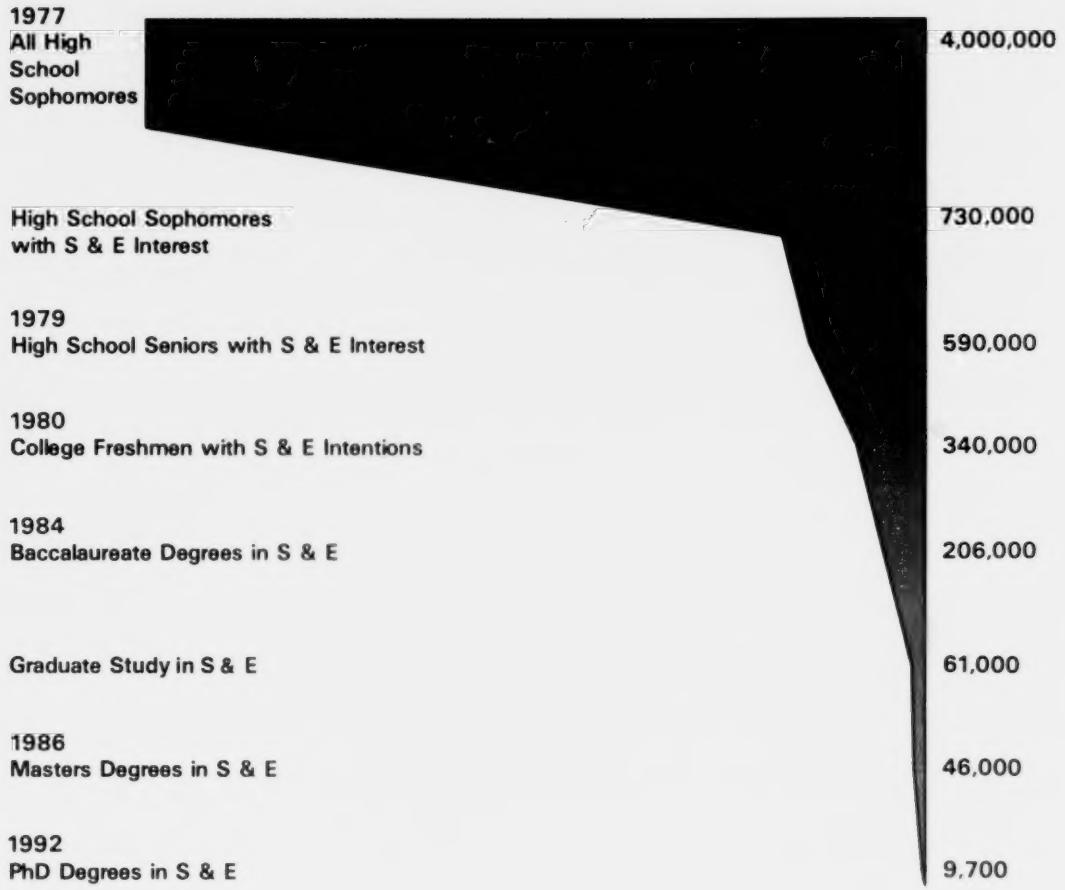
The Nation should increase the number and diversity of students graduating in science and engineering. By the year 2000 we should produce enough professionals, including more from underrepresented groups, to meet the demand for faculty and industry and Federal personnel.

Action: Universities and colleges should:

- Through their presidents, lead in creating a climate of action and accountability that accelerates the participation of underrepresented groups in all aspects of their institutions.

Figure 7

Science & Engineering Pipeline, from High School through Ph.D. Degree



Analysis of the 4 million students in the 10th grade in 1977 shows the pattern of attrition as they move through the educational pipeline. Approximately 9,700 or 0.24 percent are expected to attain the Ph.D. in science and engineering.

Source: National Science Foundation.

Set quantitative goals for recruiting, retaining, and graduating more U.S. students in the sciences and engineering, especially from underrepresented groups. Departments should set similar goals and take responsibility for assuring that more students from these groups attain doctorates and obtain faculty positions. Forgivable educational loans could be provided to students from these groups who agree to pursue faculty careers.

Provide child care for families of students and faculty, particularly because extended hours in laboratory research are crucial to professional success in science and engineering.

Forge effective partnerships between institutions which have significant enrollments from underrepresented groups and departments of science and engineering at research universities so students have access to advanced coursework and equipment.

Establish transfer centers with qualified counselors in 2-year colleges and vocational-technical schools to ensure the maximum flow of talent from these to 4-year institutions.

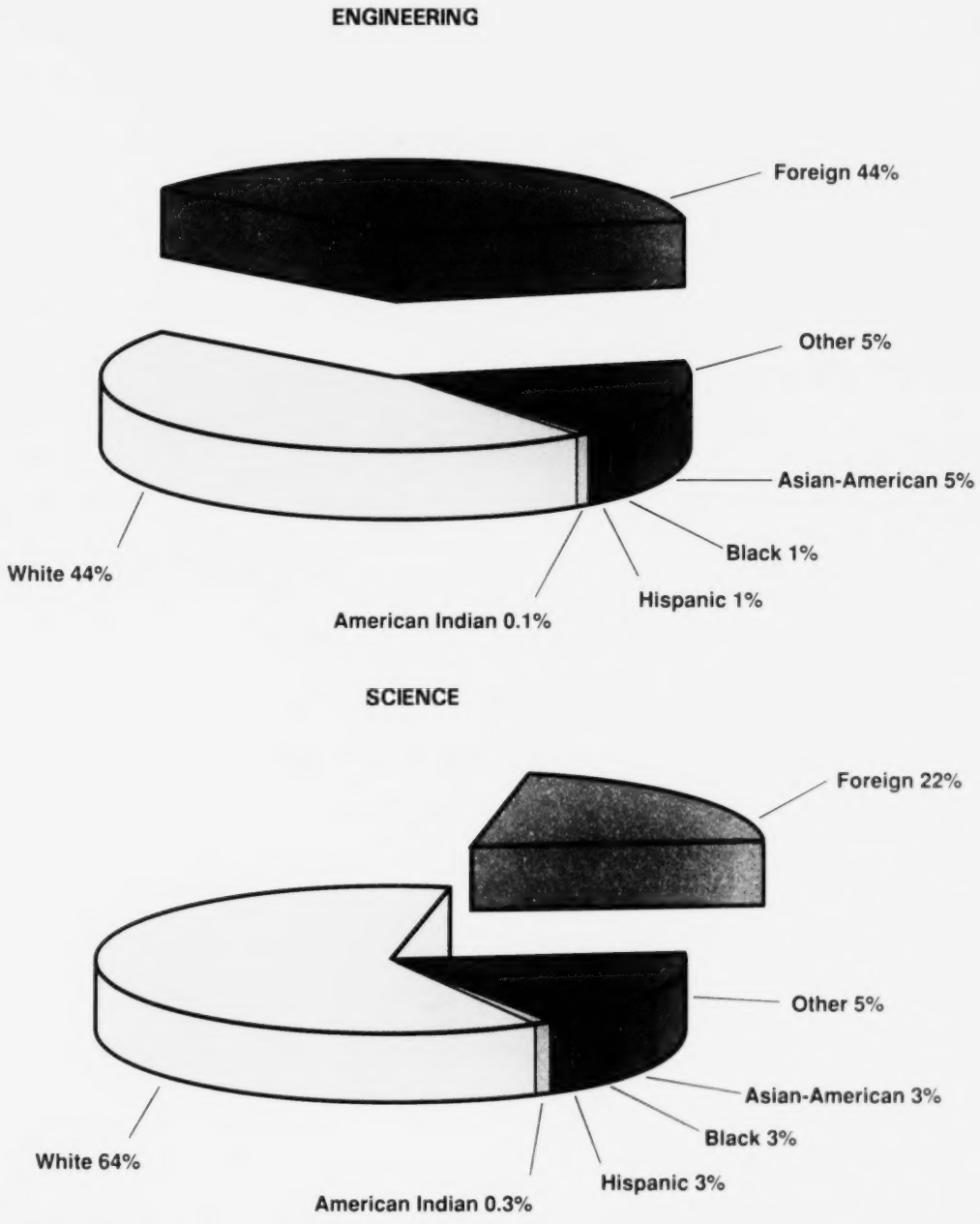
Action: The States should:

Develop quantitative plans for public higher educational institutions to recruit, retain, and graduate more students in science and engineering, especially those from underrepresented groups.

Offer scholarships in science and engineering to be honored at a public institution in that State to the top high school graduates, especially those from underrepresented groups.

Link articulation between 2-year and 4-year institutions so that 2-year college students would be encouraged to obtain the bachelor's degree in science and engineering.

Figure 8
Distribution of Graduate Students, 1986



U. S. students' declining interest in science and engineering carries through to graduate school where the participation of foreign nationals has increased dramatically in recent years.

Source: National Science Foundation.

Action: The Federal Government should:

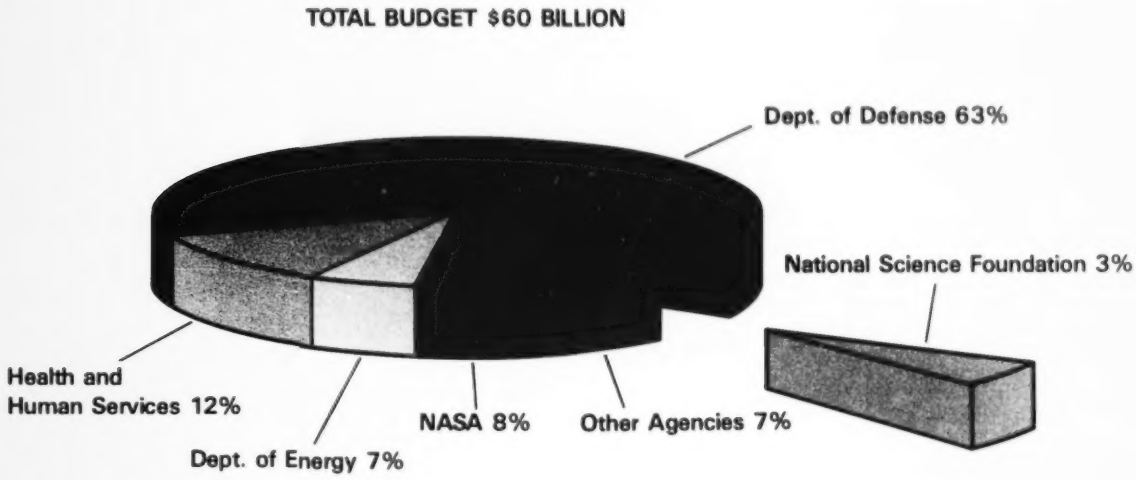
- Establish a National Research Scholars Program in Science and Engineering. The program should enable qualified high school students to have early research experiences and to earn the bachelor's degree in a science or engineering field. It should be tailored to attract minority and women students and students with disabilities, and aim to transform the size and makeup of the science and engineering workforce for a generation.
- Provide stable and substantial support for effective intervention programs that graduate quality scientists and engineers who are members of underrepresented groups.
- Establish a National Graduate Student Research Opportunities Program, targeted at minority and women students and students with disabilities, which provides fellowships and research assistantships for pursuing advanced degrees in science and engineering. This should be linked to the National Research Scholars Program to ensure continued support of these students to completion of the Ph.D.

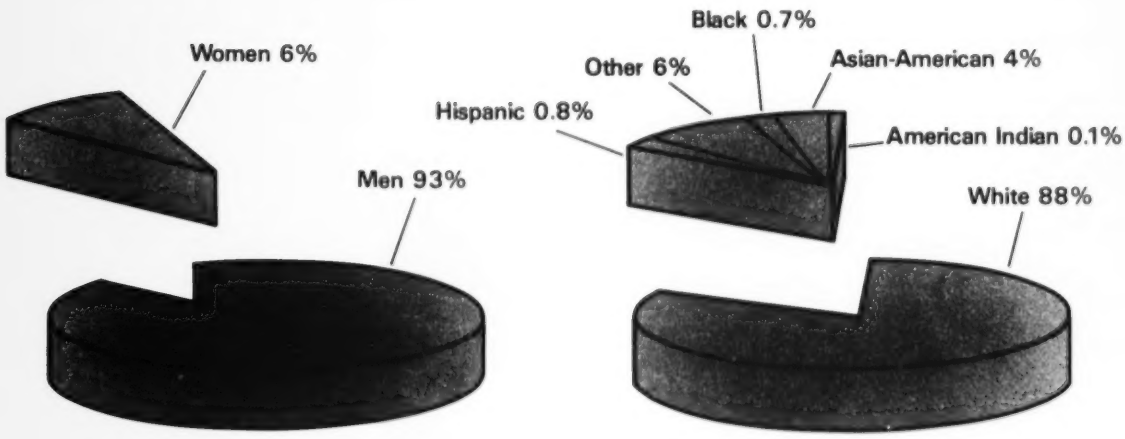
Action: Industry should:

- Through their industrial foundations, provide college scholarships and fellowships to members of the underrepresented groups who are motivated to major in science and engineering and to teach those subjects at precollege and college levels.
- Join and support alliances with Federal agencies and minority and majority universities aimed at increasing the number of graduates and researchers who are minority group members, women, or people with disabilities.

Figure 9

Federal R & D Budget and Awards, 1987





The National Science Foundation is the only Federal agency which maintains statistics on the share of its research and development dollars awarded to women and minorities.

Source: National Science Foundation.

IV. Federal Research and Development

The Nation invested $123 billion, or 2.8 percent of the gross national product, in research and development in 1987. Of this amount, the Federal Government spent approximately 50 percent, or $60 billion. These Federal funds are being spent not only within Federal agencies, but in industry, nonprofit institutions, and universities. They are most visible on university campuses, where Federal funds support nearly two-thirds of all research and development.

The Federal Government is a pacesetter in the Nation's research and development enterprise. An important issue of Federal science policy, therefore, is how the Federal Government can use its research and development leverage with educators and industry to build a world-class science and engineering workforce that reflects and exploits the new demographics of our changing America.

However, the Task Force found that Federal agencies have neither recognized nor begun to address the demographic issues that will affect the conduct of research and development in the 21st century. Until now, the role of minorities, women, and people with disabilities in science and technology has been widely seen only as an equity issue, not as the key to future national security and economic competitiveness.

The Task Force, for example, made a major effort to identify how Federal research and development programs affect the development of the scientific and engineering workforce, particularly its impact on the careers of underrepresented groups. Only one Federal agency, the National Science Foundation (NSF), representing 3 percent of the 1987 total Federal research and development budget, keeps data to monitor the demographic characteristics of those who receive its grants. These statistics show that in 1987, 6 percent of all NSF dollars were awarded to women, 0.8 percent to Hispanics, 0.7 percent to Blacks, and 0.1 percent to American Indians. All Federal science agencies need to begin to collect similar data and to assess the way their activities affect this issue.

Women

Composition.
Women are now 51 percent of the population and 45 percent of the Nation's workforce, yet they comprise only 11 percent of all employed scientists and engineers. In 1986 women earned 30 percent of all bachelor's degrees in science and engineering, 34 percent of the Ph.D.s in the life sciences, but only 16 percent of the Ph.D.s in physical sciences and 7 percent in engineering.

Background.
Despite continued career gains, women have not been choosing careers in science and engineering in the same proportions as in the nonscientific professional, business, and management areas. Women who do enter the science and engineering workforce tend to be paid less and promoted less often than white men. In 1985, women were only 13 percent of all college and university science faculty and 2 percent of engineering faculty. They were more than twice as likely as men to be in nontenure-track positions.

Women scientists and engineers also face two special problems. Even when women score higher academically than men, because of their work situation they are more likely to lose self-confidence and feel less satisfied. During their 20s and 30s — just when their career demands the most time — women need to make decisions about childbearing. One institutional response to this dilemma is Stanford University's 24-hour daycare program for faculty, staff, and students.

The pipeline.
In graduate school, a far smaller portion of women than men complete the Ph.D. This may be because women are more likely than men to be self-supporting during this period. They are also more likely to be assigned teaching assistantships, where they deal with students, rather than research assistantships, where they work with mentors and peers.

Model programs.
Thus far few intervention programs have addressed the unique needs of women, particularly in the employment area. Some intervention programs in the education arena are meeting with success.

Purdue's Engineering School's support program for women has helped raise the proportion of female engineering students from 2 percent to 21 percent. Purdue is one of the few schools that retains women engineering students at the same rate as men.

Smith College conducts summer workshops for teams of teachers and counselors to help them become proactive in advising young women to enter science fields.

The Math/Science Network, started at Mills College and expanded throughout the Nation, encourages young women to take a full complement of mathematics courses and exposes them to science and engineering careers. About 70,000 students participate annually.

Of Federal programs established to give minorities and women access to science and engineering, we found the Minority Access to Research Careers (MARC) of the National Institutes of Health closest to what we need today. MARC is a prime example of a successful Federal intervention program. It was established to remedy the low numbers of minority biomedical scientists nationwide. Over 800 students and 56 institutions have participated in the program since 1977. A 1984 survey found that 76 percent of former MARC students had enrolled in a graduate or professional school program. The National Institute of Health's Minority Biological Research Support (MBRS) is also effective in enhancing the research careers of faculty.

GOAL #4

Federal research and development funds influence the Nation's entire science and engineering effort. They generate new knowledge, and employ and train scientists and engineers. These funds should be leveraged to help develop a more diverse, world-class generation of scientific and engineering workers by the year 2000.

Action: Each Federal agency should review, within one year, its entire research and development budget, including both mainstream and special programs, and report the impact of the budget on the Nation's science and engineering workforce, especially in terms of representation of members of minority groups, women, and people with disabilities. The Office of Management and Budget should instruct all Federal research and development agencies to collect and maintain data on the participation of minorities, women, and people with disabilities in their research and development programs.

People with Disabilities

Composition.

An estimated 36 million people of working age in the United States have some disability, yet the National Science Foundation found only 94,000 working scientists and engineers in 1986. The numbers are uncertain because many people with disabilities do not identify themselves on surveys.

Background.

Progress in medical technology is improving the health and survival rates of newborns and accident victims, and both the number and proportion of the population with disabilities are growing. Now that schools are required by law to provide mainstream education for all children, more people with disabilities are being prepared to enter the workforce.

However, scientists and engineers with disabilities are more likely to be unemployed and underemployed than other scientists and engineers. An employer's willingness to hire and promote a person with a disability is frequently hampered by an institutional culture marked by prejudice.

Technology is making it practical for people with disabilities to pursue careers where intellectual ability, and not physical prowess, begets success. For example, reading machines can provide blind persons with quick access to any document. Machines that translate voice into text in real time will soon enable hearing-impaired students to participate more easily in lectures and seminars. Wide dissemination of such aids can enable more people with disabilities to enter science and engineering.

The pipeline.

Low expectations are keeping students with disabilities from participating in a full mathematics and science curriculum, particularly in science laboratory courses.

Model programs.

The State of Massachusetts Rehabilitation Commission works with students who have disabilities by helping them to determine the technical aids and other support they will need to fulfill their job goals. The program has enabled a number of the students to become scientists and engineers.

The IBM Corporation makes special efforts to hire people with disabilities, including scientists and engineers, and has instituted many special programs and policies designed to facilitate their employment and productivity.

Action: Each Federal agency should, based upon the evaluation of its programs, construct a timetable for mainstreaming all special programs for underrepresented groups, with explicit benchmarks and milestones for measurement of progress toward achieving defined objectives.

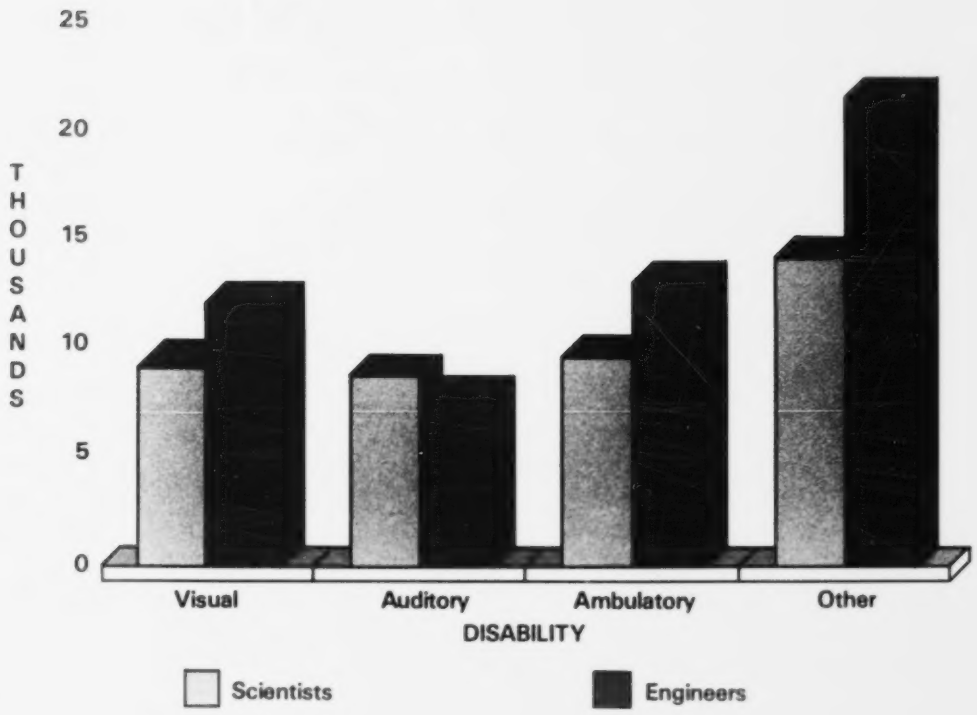
Action: Each Federal agency should develop a plan showing how its research and development programs can bring about a new, more diverse world-class workforce. They should propose devoting substantial parts of their budgets to this policy goal. The plan should include programs related to preK-12 education, higher education, research and development awards, and employment.

Action: Federal agencies and Federal laboratories should use their facilities to provide hands-on laboratory experience to a significant number of students at all educational levels, and to in-service teachers, particularly from underrepresented groups. Federal scientists and engineers should use paid leave to serve as mentors and role models.

Action: Federal agencies should reproduce the Minority Access to Research Careers (MARC) program and Minority Biological Research Support (MBRS) program in the fields of physical sciences and engineering. The models should be extended to women and people with disabilities as well.

Figure 10

Characteristics of Disabled Scientists and Engineers



Of the 4 million scientists and engineers in the U.S., only 94,000 or about 2 percent identify themselves as disabled. Engineering and computer science are the most frequent field choices of persons with disabilities.

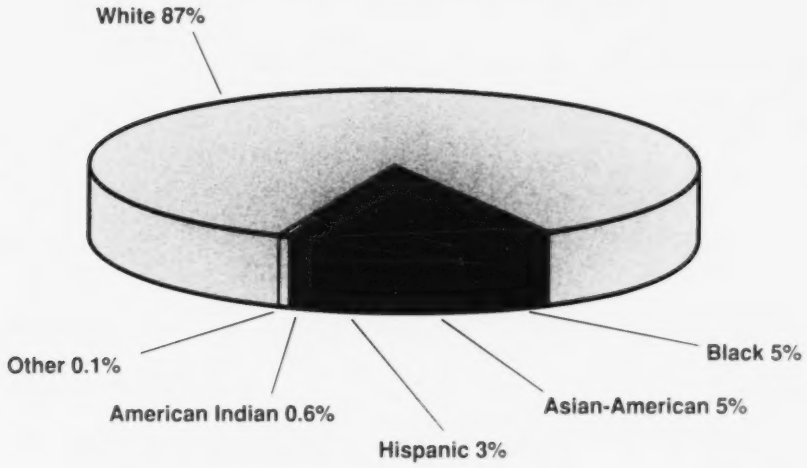
Source: National Science Foundation.

Action: The Department of Labor's Office of Federal Contract Compliance should direct its efforts towards greater focus on those Federal contractors who utilize research scientists and engineers if continued increased minority and female participation in these sectors is to occur.

Action: Each Federal agency should increase the number of minority group members, women, and people with disabilities on its science- and engineering-related advisory boards and committees.

Action: A Federal Coordinating Committee for Science, Engineering, and Technology (FCCSET) should be established by the White House Office of Science and Technology Policy to provide visibility, coordination, and accountability for agency achievement of plans. The FCCSET would receive reports, plans, and data from Federal science agencies and coordinate agency efforts. It should communicate with the National Action Council as the Action Council monitors national progress.

Figure 11
Federal Scientists and Engineers, 1987



The Federal government employs almost twice as many scientists and engineers who are women and minorities in 1987 as 1977. Women grew from 7 percent of the science and engineering workforce to 15 percent over this period.

Source: U. S. Office of Personnel Management.

V. The Federal Government as Pacesetter

Historically, underrepresented groups tend to cluster in fields they perceive as friendly and where they can exercise their talents fully, without discrimination and with good chance of recognition and reward. Employers nationwide must make science and engineering jobs attractive to these groups. If they fail to do so, minority-group members, women, and people with disabilities will see little or no role for themselves at the top of the science and engineering professions. They may decide that the years of graduate and postgraduate work and foregone income are not worth the effort. As a result, they may not develop to their fullest potential as scientists and engineers, and the Nation will not reap the full benefit of their contributions.

The Federal Government has been a path for career entry and advancement for underrepresented groups. Federal employment has been open, for example, to people with disabilities due to veterans' preference rules adopted after World War II. Affirmative action and equal opportunity laws have spurred hiring and promotion of women and members of minority groups.

We recommend that the Federal Government now recognize as an additional urgent role the need to use its employment practice as a lever for expanding and diversifying the Nation's science and engineering workforce at all levels. The system should be as open as possible to entry-level personnel. It can widen the pool of entering scientists and engineers by providing internships for aspiring professionals. It can extend efforts to recruit scientists and engineers from among minorities, women and people with disabilities. It can make known the way benefits of Federal service compensate for salaries that are lower than in industry.

But in addition to competing for the present pool of underrepresented scientists and engineers, the Federal Government can help "grow its own" by involving itself in the entire education pipeline. It can also widen the pool by encouraging Federal employees wishing to enter science and engineering or upgrade their skills to obtain the necessary education, job experience, and training.

American Indians

Composition.

American Indians enrolled in the 278 recognized tribes in the lower 48 States and 300 Aleut and Eskimo villages in Alaska number 1.4 million. They make up 0.6 percent of the U.S. population and 0.7 percent of all employed scientists and engineers. They hold 0.3 percent of all bachelor's degrees and 0.16 percent of all Ph.D.s in science and engineering. In 1986, 37 Ph.D.s in science and engineering were awarded to people who identified themselves as American Indians.

Background.

Many American Indians, including those holding degrees and professional jobs, do not want to be mainstreamed into the general American community. For the most part they prefer to also maintain their separate tribal identity.

The pipeline.

Approximately half of the American-Indian population enrolled in tribes is under the age of 21 and receives an elementary and secondary education in mathematics and science that parallels that in poor rural areas. Teacher turnover is high. Role models from their own group are few; in Bureau of Indian Affairs schools, less than 16 percent of the teachers are American Indians. Mathematics teaching tends to be by rote; there is little laboratory science. Many of the students who do enroll in college return home before they graduate.

Model programs.

The American Indian Science and Engineering Society (AISES) has an exemplary program that encourages American Indian students to pursue college science and engineering majors. In 1987-88, AISES had 627 student members. Through on-campus chapters, students receive peer support, assistance in finding jobs, and tutoring.

The United South and Eastern Tribes operate a health care-science internship program in partnership with the National Institutes of Health and the Food and Drug Administration. The program arranges jobs for American Indian students in these agencies' laboratories so that students gain research experience and see themselves as scientists. The aim is to provide the incentive for students to complete the college science degree and go on to graduate or medical school.

With the assistance of the Office of Personnel Management, the Task Force studied the 236,757 current full-time scientists and engineers employed with the Federal Government in 1987. The aim was to determine the representation and rank of men and women, Blacks, Hispanics, Asian-Americans, American Indians, and employees who identified themselves as disabled. We found that overall employment of Federal scientists and engineers increased 24 percent between 1977-87 while employment of women and minorities approximately doubled. An important opposite trend was the 5 percent decrease in the number of employed scientists and engineers with disabilities, perhaps due to retirements of World War II veterans and polio victims.

Although substantial gains have occurred, Federal employment has not kept pace with the increase in women scientists and engineers emerging from the education pipeline. In 1987, only 10 percent of the Ph.D.s employed were women, although women earned 17 percent of the Ph.D.s awarded in science and engineering. Further, their proportion of the entire Ph.D. population had risen to 15 percent.

In a matched cohort of Ph.D.s, in 1987, after 10 years in the Federal service, 57 percent of all women, 65 percent of the Black, Hispanic, and American Indian men, 71 percent of the Asian-American men and 75 percent of white men scientists and engineers were making $50,000 or more a year in 1987.

Goal #5:

The Federal Government should continue to be a pacesetter in developing a work environment that is accessible, equitable, and favorable to attracting and advancing groups now underrepresented in science and engineering.

Hispanics

Composition.

The U.S. Hispanic population is the fastest-growing minority group, and comprises 9 percent of our population. It includes Cuban immigrants who tend to be members of the middle class and Mexican-Americans and Puerto Ricans who are more frequently of lower socioeconomic status. Forty percent of Hispanic children live in poverty.

Hispanics constitute 2 percent of all employed scientists and engineers, and hold 2 percent of all bachelor's degrees and one percent of all Ph.D.s in science and engineering.

Background.

Most Hispanic parents have high aspirations for their children but they often do not encourage them to go to college, particularly if this requires that they move from home.

The pipeline.

Overwhelmingly enrolled in schools in poverty areas, many Hispanic children are hampered by an inadequate basic education, including poor instruction in mathematics and science. Of the Hispanic youth who go on to higher education, 43 percent go to 2-year colleges. That percentage is closer to 60 percent in States with a large community college system. Hispanics do not have a network of 4-year colleges to nurture indigenous talent as Blacks do with the Historically Black Colleges and Universities.

Model programs.

The Math, Engineering, and Science Achievement (MESA) programs in communities in the West and Southwest are a prime example of a successful intervention program. This partnership between schools, universities, and industry identifies talent, offers tutoring and counseling, and provides role models from industry to spark student interest in maintaining good grades in school. A key aspect of the program is parental involvement. MESA centers are working with 131 high schools and reaching about 4,000 students a year. The project reports that 90 percent of these students go to a college or university, and 66 percent are science and engineering majors.

The Hispanic Mother-Daughter Project at Arizona State University focuses on 8th-grade girls, building on the strong mother-daughter relationships intrinsic to Hispanic families. The project prepares young women for higher education and increases their career aspirations. In some cases, mothers are pursuing college degrees along with their daughters.

Action: Each Federal agency with requirements for scientists and engineers should review its existing Federal Equal Opportunity Recruitment Plan (FEORP), and use it as a guide to develop agency-specific data for hiring, advancing, and retaining underrepresented groups in science and engineering. The data collected will be forwarded on an annual basis to the Federal Coordinating Committee for Science, Engineering, and Technology committee of the Office of Science and Technology Policy and to the National Action Council, which will monitor progress.

Action: The plan should include a provision for funding technical aids in order to facilitate the hiring and advancing of disabled professionals who require this kind of accommodation.

Action: Federal agencies should offer visible career ladder programs for entrants from underrepresented groups into the science and engineering career fields.

Action: Agencies should establish outreach public awareness programs to present science and engineering as prestigious and rewarding careers, and to promote the concept that professionals in Federal service can develop their talents to maximum potential without discrimination and with recognition and professional esteem.

Asian-Americans

Composition.

Asian-Americans make up only 2 percent of the U.S. population, but they are a much larger proportion — 6 percent — of the science and engineering workforce. They hold 4 percent of all bachelors' degrees and 7 percent of the Ph.D.s in science and engineering.

Background.

There is a contrast between Asian-American involvement in science and engineering and participation by other minority groups. One explanation is socioeconomic: many Asian-Americans came from the middle and upper classes of society in their country of origin and remain in these socioeconomic groups in America. Another explanation may be the influence of the Asian-American culture, which places a high premium on hard work, obedience to authority, and respect for education.

Studies of patterns of mathematics and science learning in Japan and China show that Japanese and Chinese parents believe that every child can be proficient in mathematics and science if the child works hard; low student achievement is due to less effort. By contrast, American parents are more likely to believe that mathematics and science proficiency stems from innate talent, with low achievement due to lack of ability. And even though American schoolchildren are offered less material in school, American parents are more satisfied with their children's educational progress and the schools they attend than are Japanese and Chinese parents. Many Americans take high school dropout rates of 25 percent for granted, whereas some Japanese become alarmed if the rate reaches 5 percent.

It is important to remember, however, that Asian-Americans are diverse in socioeconomic makeup and national origin. Some Asian-Americans, particularly refugees and second- and third-generation youth, perform less well.

The pipeline.

Asian-American students consistently score highest on the Scholastic Aptitude Tests. They also excel in science and engineering fields in college. Preference for careers in quantitative fields, however, does not extend to Asian-American women, who drop out of the education pipeline at about the same rate as other American women.

Model programs.

Some programs are trying to transfer the values and habits of achieving Asian-American students to members of other groups. The Professional Development Program at the University of California, for example, uses one Asian-American ingredient of success: group study. Using this and other methods, the Black and Hispanic students in the program now score better in calculus than many other students.

VI. The Influence of Culture

Parents and the home shape values. They can give children positive attitudes and skills that make them interested in and comfortable with mathematics and science. There is strong evidence that parents' expectations are strongly associated with children's participation in science-related activities. Some homes, including many Asian-American ones, are conducive to nurturing these values. Other groups can learn from them.

Young people are, to a great extent, influenced by the popular culture— television, movies, video, music. The percentage of 17-year-olds watching television 3 or more hours a day, rose from 26 percent in 1978 to 56 percent in 1986.

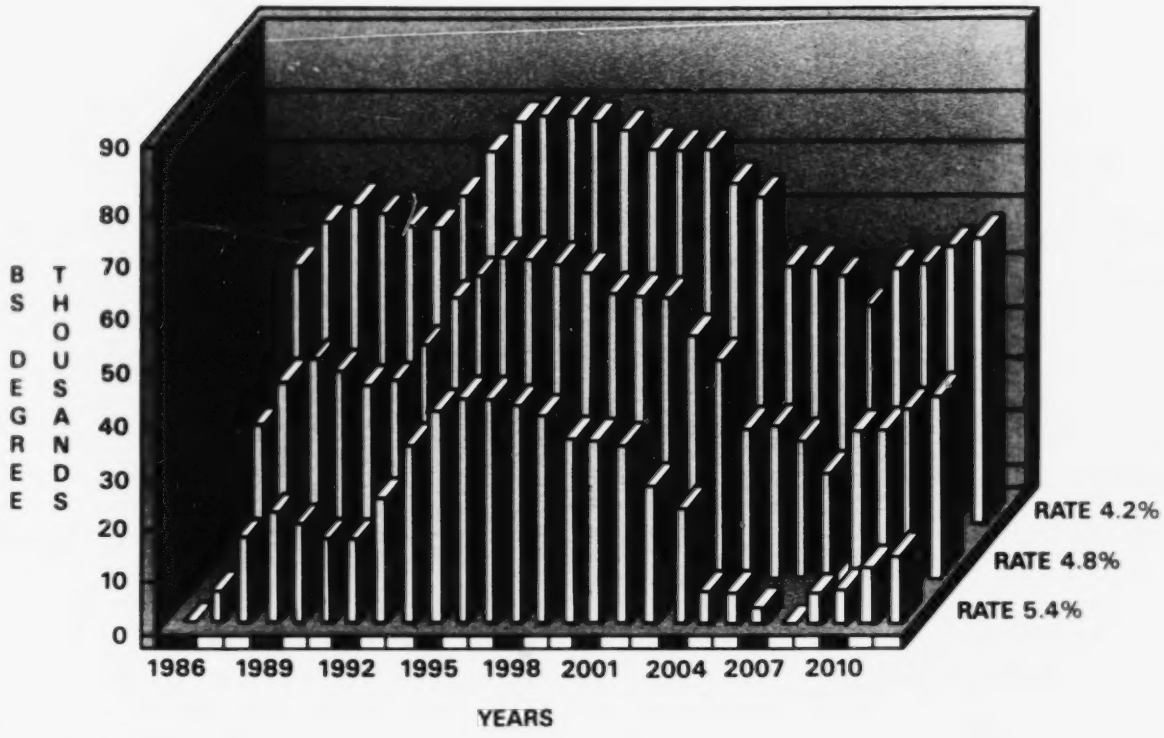
We heard many complaints during our public hearings that the entertainment industry has created powerful negative stereotypes. Scientists are depicted as mad wizards or "nerds"; women are shown as helpless or sex objects. The industry glorifies the human body as "good" only when it is beautiful and complete. Disfigured people are often portrayed as oddities and rarely shown as competent or as heroes.

The entertainment industry's portrayal of high technology as evil or laughable, along with the industry's stress on materialism and instant gratification, are antithetical to the values required to pursue science or engineering. To enter these fields young people must swim against the powerful currents in the mass culture. It is hardly surprising that so many students drop mathematics and science as soon as the decision whether or not to continue is put in their hands.

The entertainment industry and television can be a powerfully positive tool in a national initiative to bring more kinds of people into science and engineering. A television series on lawyers sparked a rise in law school enrollments. A recent movie about Navy fliers increased naval recruitment. A film such as "Stand and Deliver" can excite our youth about learning mathematics. "Square One" and "3-2-1 Contact" are public television shows that engage young children in mathematics and science. A recent survey, for example, found that 50 percent of all U.S. 10-year-olds had watched "3-2-1 Contact" at some time, and 13 percent had watched it regularly.

Figure 12

Shortfall of Future B.S. Degrees in Science and Engineering



Projected shortfalls of future B.S. degree holders are related to the declining number of young people in our population. Three scenarios are presented based on the percent of 22-year-olds earning bachelor's degrees, starting with 4.2 percent which was the rate experienced in the early 1970s. It is estimated that the rate would have to rise to 6.8 percent to eliminate the shortfall.

Source: National Science Foundation.

More than half of the children who watched also engaged in some science activity as a result—a finding that suggests that the power of television is underexploited. And it is important to note that positive responses did not vary with socioeconomic status, sex, or race.

We call on the entertainment industry to act in partnership with schools, business, and the community to increase the attractiveness and importance of mathematics and science to American youth and to purge negative images.

Goal #6:

Our Nation's future hinges on having an ample supply of people who achieve in mathematics and science, are science-literate adults, and perform technical jobs with world-class competence. The entertainment industry and the mass media—powerful influences in shaping society's values—must participate in reshaping popular attitudes toward science and engineering.

Action: Videos, recordings, and other entertainment materials that awaken interest in science and engineering, and explain their importance, should be readily available to community groups, libraries, and museums, especially in low-income areas.

Action: A task force of representatives from the entertainment industry should report within the next 18 months on how this industry, along with the mass media, can spark the imagination and values of all Americans, including our youth, to reach the six national goals set forth in this report.

Conclusion: We Can Change America

The problem we face in the science and engineering professions stems from powerful underlying forces in American society, including discrimination, poverty, and deficits in education.

Poverty continues to grip a large number of children, including a disproportionate share of minority children. The Nation's public schools have traditionally provided a common pathway to the American dream of economic opportunity, but today the schools are hard pressed to serve the needs of children-at-risk. Most elementary and secondary schools do an inadequate job of preparing students in mathematics and science. Colleges and universities recruit too few science and engineering students, particularly students from underrepresented groups and do not retain enough through completion of the bachelor's degree. Graduate departments are not widening their pool of Ph.D.s with enough American students, especially those from underrepresented groups. The problem is continued by employers who have not yet opened career paths widely and visibly enough to prospective talent. It is further exacerbated by the mass culture.

Each sector of the Nation's science and engineering workforce, accustomed to operating independently, must now work with all the others towards a set of common goals.

The Task Force has outlined six goals and associated actions to change America. We are confident that change can occur.

We urge the Nation to share our goals of an America in which all citizens receive a quality education, have access to economic opportunity, and are the informed voters that a free society demands.

Task Force Membership List

Co-Chairs

Mr. Jaime Oaxaca
Corporate Vice President
Northrop Corporation

Dr. W. Ann Reynolds
Chancellor
California State University System

Members

Dr. Howard G. Adams
National Consortium for Graduate Degrees in Engineering, Inc.

Dr. Kenneth Bell
Delaware State College

Dr. E. Ann Berman
Department of Defense

Mr. James A. Biaglow
National Aeronautics and Space Administration

Ms. Ferial Bishop
Environmental Protection Agency

Jo Anne Brasel, M.D.
Harbor UCLA Medical Center

Dr. Mary E. Carter
Department of Agriculture

Dr. Alan Clive
Federal Emergency Management Agency

Dr. Mary E. Clutter
National Science Foundation

Dr. Joseph G. Danek
National Science Foundation

Mrs. Jill Emery
Department of Labor

Mr. Herbert Fernandez
Department of Defense

Dr. Essex E. Finney, Jr.
Department of Agriculture

Ms. Claire E. Freeman
Department of Defense

Ms. Stella Guerra
Department of Defense

Dr. Ruth A. Haines
Department of Commerce

Ms. Penelope M. Hanshaw
Department of the Interior

Mr. Norbert Hill
American Indian Science and Engineering Society

Ms. Amoretta H. Hoeber
TRW, Inc.

Mr. M. Carl Holman*
National Urban Coalition

Mr. James Jeffers

Dr. Harriett G. Jenkins
National Aeronautics and Space Administration

Ms. Antionette G. Joseph
Department of Energy

Ms. Brenda Kay
Department of the Interior

Dr. Ruth L. Kirschstein
Dept. of Health and Human Services

Mr. Robert Cyrus Laughter
Laughter Corporation

Ms. Fran Lopes
Office of Personnel Management

Dr. Shirley Malcom
American Association for the Advancement of Science

Mr. Frank B. McDonald
National Aeronautics and Space Admininstration

Ms. Stephanie Lee-Miller
Department of Health and Human Services

Mrs. Barbara Morgan
Teachers in Space Program

Mr. Robert H. Morris
Federal Emergency Management Agency

Dr. Norine Noonan
Office of Management and Budget

Ms. Kathleen Peery
Department of Energy

Mrs. Shirley Peterson
Department of Labor

Mr. Raul Ernie Reyes
National Aeronautics and Space Aministration

Dr. Miguel Rios, Jr.
Orion International Technologies, Inc.

Miss Gloria R. Sabatini

Dr. Lawrence Scadden
Electronic Industries Foundation

Mr. Nathaniel Scurry
Environmental Protection Agency

Mr. Curtis J. Smith
Office of Personnel Management

Mrs. Patricia McGill Smith
Department of Education

Ms. JoAnn Sondey-Hersh
Department of Commerce

Mr. Alvin Thomas
Department of Transportation

Ms. Sonia Mejia-Walgreen
Southeastern Massachusetts University

Dr. Luther Williams
Department of Health and Human Services

Ms. Nina Winkler
Department of Education

* * * * *

Ms. Sue Kemnitzer
Executive Director, Task Force

* The Task Force regrets the death of its esteemed member, M. Carl Holman on August 9, 1988.

Public Hearings Witnesses

Albuquerque, New Mexico - September 22, 1987

Ms. Connie Alexander
National Aeronautics and Space Administration

Mr. Ted L. Barber
U.S. Army Atmospheric Science

Ms. Teresa Barts

Dr. Henry Casso
Project Uplift

Dr. Jack Cole
University of Arizona

Honorable Pete Domenici
U.S. Senate (Represented by Mr. Tony Gallegos)

Dr. Ann Erickson
Salt Lake Community College

Dr. John Foley
Los Alamos National Laboratory

Ms. Rosemary Frederickson
EG&G

Ms. Elizabeth Gallegos
Office of Senator Jeff Bingaman

Mr. John Garcia
Hispanic Chamber of Commerce

Dr. Leo Gomez
Sandia National Laboratory

Dr. Richard J. Griego
University of New Mexico

Mr. Francisco A. Guevara
Mexican Amercian Engineering Society

Mr. Norbert Hill
American Indian Science and Engineering Society

Mr. Richard Jimenez
Society of Hispanic Professional Engineers

Dr. Nina Kay
National Aeronautics and Space Administration

Mr. Gregory Kennedy
Alamogordo Space Center

Dr. Robert L. Knutilla
U.S. Geological Survey

Dr. Julie Hayes Lutz
Washington State University

Dr. Kirk MacGugan
Protection and Advocacy System

Ms. Louella Marr
Luna Vocational Technical Institute

Dr. Dewayne Matthews
New Mexico Commission on Higher Education

Mr. Matthew D. Padilla
University of New Mexico

Honorable William Richardson
U.S. House of Representatives (Represented by Mr.Gary Townsend)

Ms. Rose Marie Rodriquez
American GI Forum of New Mexico

Dr. Nancy Felipe Russo
Arizona State University

Mr. Jim Tarro
Digital Equipment Corporation

Ms. Katherine H. Tijerina
New Mexico State University

Ms. Sheila Tobias

Ms. Barbara Torres
BDM Corporation

Mr. Jerry Watkins
New Mexico School for the Visually Handicapped

Chicago, Illinois - October 29, 1987

Dr. Ted Ansbacher
Museum of Science and Industry

Dr. Elaine J. Copeland
University of Illinois-Urbana

Mr. Cecil Curtwright
National Association of Minority Engineering Program Administrators

Ms. Jane Daniels
Purdue University

Ms. Patricia Finn
Association for Women in Science

Dr. Jane Butler Kahle
Purdue University

Mr. Thomas Kucera
American Chemical Society

Ms. Christa Lane-Larsen
3-M Company

Dr. Donald N. Langenberg
University of Illinois at Chicago

Dr. William K. LeBold
Purdue University

Dr. Arlene Lennox
Fermi Laboratory

Dr. Thomas L. Martin, Jr.
Illinois Institute of Technology

Dr. Jon D. Miller
Northern Illinois University

Dr. Richard Neblett
National Action Council for Minorities in Engineering

Dr. Robert W. Springer
Argonne National Laboratories

Ms. Carolyn Stern
Northwestern University

Mr. Anibal Taboas
Argonne National Laboratories

Honorable James Thompson
Governor of Illinois
(Represented by Ms. Vicki Sebela)

Dr. Marion C. Thurnauer
Association for Women in Science

Mr. William T. Trent
University of Illinois-Urbana

Dr. Yvonne Walker-Taylor
Wilberforce University

Dr. Izaak Wirszup
University of Chicago

Kansas City, Missouri - December 1, 1987

Dr. Don Ahshapanek
Haskell Indian Junior College

Dr. Elizabeth Berman Appelbaum

Honorable John Ashcroft
Governor of Missouri
(Represented by JoeAnn Platt)

Dr. Manuel Berriozabal
University of Texas- San Antonio

Mr. Jose de Jesus Esteban
National Weather Service

Dr. Joseph L. Estrada
Department of Health and Human Services

Ms. Cheryl Fisher
Parkview High School

Dr. Gene Hampton
Science Pioneers, Inc.

Dr. Diana G. Helsel
University of Missouri-Columbia

Ms. Karen Hummel and
Mr. Tom Cummings
Mid-America Consortium for Engineering and Science Achievement

with

Douglas Juarez and
Dawn Cunningham
Westport High School

Dr. Edith Irby Jones
National Medical Association

Dr. Jerry Kollros
University of Iowa

Dr. Patricia MacCorquodale
University of Arizona

Ms. Ruth Margolin
University of Missouri-Kansas City

Mr. John P. McTague
Ford Motor Company

Dr. Charles Rankin
Kansas State University

Dr. Walter S. Smith
University of Kansas

Mr. Nate Thomas
National Association of Minority Engineering Program Administrators

Los Angeles, California - January 14, 1988

Mr. Raul Alvarado, Jr.
Rockwell International

Ms. Eva W. Bien
Naval Weapons Center, China Lake

Mr. Ralph Casarez and
Mr. Robert Cole
Casarez and Cole

Ms. Helga Christofferson
Lawrence Livermore Laboratory

Dr. Eugene H. Cota-Robles
University of California, Berkeley

Dr. Stuart E. Gothold
Los Angeles County Office of Education

Ms. Nancy Guitterez
Pacific Bell

Ms. Dorothy Hudig
University of Nevada

Ms. Nancy Kreinberg
University of California, Berkeley

Dr. Raymond B. Landis
California State University, Los Angeles

Ms. Frances Manion
Santa Monica Community College

Dr. Diane Ross
California State University, Fullerton

Dr. James M. Rosser
California State University, Los Angeles

Mr. Jesse Rubalcaba
California Institute of Technology

Ms. Syvila Weatherford
National Council of Black Engineers and Scientists

Atlanta, Georgia - March 2, 1988

Ms. Debbie Baldridge
Discovery Learning

Mr. James G. Breene
International Business Machines Corporation

Ms. Iris M. Carl
Houston School District

Ms. Carolyn C. Chesnutt
Southeastern Consortium for Minorities in Engineering

Dr. Thomas W. Cole, Jr.
Clark College

Ms. Karen Darling
Department of Agriculture

Dr. Etta Falconer
Spelman College

Ms. Isabella N. Finkelstein
Clark College

Ms. Chandra French
Clark College

Ms. Polly Anna Harris
Bearden High School

Dr. Joe Johnson
Atlanta University Center, Inc.

Ms. B. K. Krenzer
Society of Women Engineers

Mr. Bill Linder-Scholer
Cray Research Foundation

James O. Mason, M.D.
Centers for Disease Control

Dr. Charles Meredith
Atlanta University Center

Mr. Juan Sabater
International Business Machines Corporation

Mr. William Shackelford
Industry Education Connection, Enterprises

Dr. Melvin R. Webb
Clark College

Boston, Massachusetts - April 7, 1988

Mr. Elmer C. Bartels
Massachusetts Rehabilitation Commission

Dr. Janice Button-Shafer
American Physical Society

Dr. Valerie Crane
Research Communications, Ltd.

Ms. Patsy Dickinson
Radcliffe College

Ms. Phyllis Dohanian
Boston Museum of Science

Dr. Millie Dresselhaus
Massachusetts Institute of Technology

Mrs. Karen Henry
Society of Women Engineers

Dr. Kenneth M. Hoffman
Massachusetts Institute of Technology

Dr. Gerald Holton
Harvard University

Dr. Matina Horner
Radcliffe College

Dr. Lilli Hornig
Wellesley College

Dr. Elizabeth Ivey
Smith College

Dr. Christine Jones
Harvard-Smithsonian Center for Astrophysics

Dr. Raymond C. Kurzweil
Kurzweil Computer Products, Inc.

Ms. Vivien Li
Commonwealth of Massachusetts

Dr. Gilbert J. Lopez
Columbia University

Dr. Shirley McBay
Massachusetts Institute of Technology

Dr. Margaret Rossiter
Cornell University

Dr. Mary Beth Ruskai
Wellesley College

Ms. Joann Sherwood-Leighton
Middlesex Community College

Ms. Andrea Shlipak
Radcliffe College

Dr. Harlee Strauss
Gradient Corporation

Dr. Norma Ware
Radcliffe College

Dr. Sheila Widnall
Massachusetts Institute of Technology

Baltimore, Maryland - May 4, 1988

Dr. Michele Bloch
Uniformed Services University

Dr. George Carruthers
Naval Research Laboratory

Dr. Rita Colwell
University of Maryland

Mr. Thomas E. Daniels
National Technical Association

Dr. Joseph T. Durham
Community College of Baltimore

Dr. Homer D. Franklin
Olive-Harvey College, Chicago

Dr. John Gavin
EER Systems

Mr. Ted Habarth
Project Journey - GEM Program

Ms. Gertrude R. Jeffers
Governor's Office for Handicapped Individuals

Ms. Ann Kahn
National Mathematical Sciences Education Board

Dr. Edward C. Keller
West Virginia University

Ms. Marylin Krupsaw
George Washington University

Ms. Freda W. Kurtz
Federally Employed Women

Dr. David Lunney
East Carolina University

Dr. Barbara Mandula
Environmental Protection Agency

Dr. Lucy Morse
University of Central Florida

Mr. Clennie Murphy
Department of Health and Human Services

Dr. Janice Petrovich
ASPIRA Institute for Policy Research

Dr. Harold W. Stevenson
University of Michigan, Ann Arbor

Mr. Thomas G. Sticht
Applied Behavior and Cognitive Sciences, Inc.

Mr. Jerry Teplitz
Jerry Teplitz Enterprises

Dr. Anne Thompson
American Geophysical Union

Dr. Carol Weller
University of Utah

Dr. Jo Schlicht Wessels
Jefferson County Public Schools, Colorado

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Committee for Economic Development, Research and Policy Committee. *Children in Need: Investment Strategies for the Educationally Disadvantaged*. New York, New York, 1987.

Johnston, William B. *Workforce 2000: Work and Workers for the Twenty-first Century*. Indianapolis, Indiana: Hudson Institute, 1987.

Malcom, Shirley. *Equity and Excellence: Compatible Goals*. Washington, D.C.: American Association for the Advancement of Science, December, 1984.

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National Science Board Commission on Precollege Education in Mathematics, Science and Technology. *Educating Americans for the 21st Century*. Washington, D.C.: National Science Board, 1983.

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Vetter, Betty M.; Babco, Eleanor L. *Professional Women and Minorities: A Manpower Data Resource Service*. Washington, D.C., December, 1987.

Law Establishing the Task Force

Public Law 99-383

Sec. 8. (a) It is the purpose of this section to establish a task force on women, minorities, and the handicapped in science and technology to:

(1) examine the current status of women, minorities, and the handicapped in science and engineering positions in the Federal Government and in federally assisted research programs;

(2) coordinate existing Federal programs designed to promote the employment of women, minorities, and the handicapped in such positions;

(3) suggest cooperative interagency programs for promoting such employment;

(4) identify exemplary State, local, or private sector programs designed to promote such employment; and

(5) develop a long-range plan to advance opportunities for women, minorities, and the handicapped in Federal scientific and technical positions in federally assisted research, and to coordinate the activities of participating agencies with the Committee on Equal Opportunities in Science and Engineering established by section 36 of the National Science Foundation Authorization and Science and Technology Equal Opportunities Act (42 U.S.C. 1885c), after the termination of the task force established by this section.

(b) For purposes of this section, the term "participating agency" means

(1) the National Science Foundation;

(2) the Department of Health and Human Services;

(3) the National Aeronautics and Space Administration;

(4) the Environmental Protection Agency;

(5) the Department of Agriculture;

(6) the Department of Defense;

(7) the Department of Education;

(8) the Department of Energy;

(9) the Department of Commerce; and

(10) the Department of the Interior.

(c) (1) The task force on women, minorities, and the handicapped in science and technology shall be composed of individuals appointed by participating agencies pursuant to this subsection.

(2) The head of each participating agency shall appoint two individuals to serve as members of the task force. If an appointed member is unable to serve for the duration of the task force, the head of the participating agency who appointed that member shall appoint another individual to fill the vacancy.

(3) Task force members may be appointed from private business, academia, professional associations, or nonprofit foundations.

(d) The task force shall prepare and submit a report on its findings and recommendations to the President, the Congress, and the head of each participating agency not later than December 31, 1989.

(e) The Office of Science and Technology Policy shall call the first meeting of the task force not later than 90 days after the date of enactment of this Act, shall ensure that each participating agency has appointed two members, and shall assist the task force to meet its objectives.

(f) (1) Members of the task force not otherwise employed by the Federal Government shall be reimbursed for travel, subsistence, and other necessary expenses incurred by them in carrying out the duties of the task force.

(2) The Director of the National Science Foundation shall make provision for administrative support of the task force, and may enter into agreements with the heads of other participating agencies to facilitate the work of the task force.

(g) The task force shall terminate on January 31, 1990.